SATURDAY, AUGUST 28, 1880.

BOOKS RECEIVED.

A TREATISE ON COMPARATIVE EMBRYOLOGY. By Francis M. Balfour, M. A., F. R. S., in two volumes. Vol. 1. Macmillan & Co., London. 1880.

Macmillan & Co. have recently forwarded to us this very interesting volume of over 300 pages, abundantly illustrated, the first part of a work upon which we believe the author has been constantly occupied since the publication of his "Development of the Elasmobranch Fishes," in 1878. The second volume is still in press, and will deal with the Embryology of the Vertebrata; while this, the first volume, is devoted to the Invertebrata, omitting the Protozoan forms, and it includes in the beginning of the book an outlined history of the Ovum, as it appears in both the Vertebrate and Invertebrate types.

This is by far the most important book that Mr. Balfour has undertaken, and, in practical importance, takes the precedence of any work that has yet appeared in this branch of biological science.

In his "Elements of Embryology," written with Prof. Foster of Cambridge in 1874, and his "Elasmobranch Fishes," besides numerous contributions to the *Quarterly Journal of Microscopical Science*, and the societies, the author has won a position among European embryologists which makes this work doubly valuable. Merely for an expression of his opinion on many mooted questions, the book will be welcomed on both sides of the Atlantic; but it contains, moreover, as full a history of every form as scientific investigation up to the present time has furnished, with a manifest endeavor throughout to do justice to every investigator. The absence of such a work has long been felt by American students. Few of our libraries have been able to obtain, to anything like completeness, the works of biological specialists; in great measure because such works appear in the form of scattered memoirs, difficult to procure even at the time of publication. In the full field of French, German, Italian and Russian investigations, the danger of completely overlooking the researches of others is constantly discouraging. It may be in appreciation of this general want that the author has placed full notices of his sources of information at the end of each chapter where such reference is made, and, in addition to an index of subjects, has inserted at the close of the volume a classified bibliographical index. This renders each subject exceptionally clear, and places the student in a much fairer way of hunting up the literature of his specialty than has been possible hitherto. In these respects, the book is a model for works of this character.

The science of embryology, now ripe for an eclectic work of this description, has grown rapidly from its infancy in the middle of the present century to the importance of a separate and elaborate branch. With its voluminous literature, it is strange that with one exception, a small volume by Packard, no attempt has been made to collate opinions or handle the subject as a whole. In the phylogenetic light alone, Embryology ranks as a vital portion of Biology; in this connection may be quoted a few lines from the introduction: "It has long been recognized that the larvae and embryos of each group pass, in the course of their development, through a series of stages in which they more or less completely resemble the lower forms of the group." The author shows the bearing of the Darwinian theory upon this fact. While morphology may establish the relations of genera, we turn to Embryology for the basis of a wider classification. Its bearing upon Comparative Anatomy is a patent fact. So it is in the interest of the history of development, or in the relation of a given type to its progenitors, as well as in the morphology and physiology of individuals that embryology is of constantly increasing importance. This is, in part, pointed out by the author in the introduction of the work. More specifically he states the aims of the present work as two-fold: (1) To form a basis for Phylogeny (or the history of the race or group); and (2) to form a basis for Organogeny (or the origin and evolution of organs).

In course of a review of the phenomena of reproduction, as witnessed among the Protozoa and Metazoa, the transition from single to compound organisms is clearly stated: "It must be remembered that a single individual Metazoon, is equivalent to a number of Protozoa coalesced to form a single organism in a higher state of aggregation. It results from this that the segmentation of the ovum which follows the sexual act may be compared to the product of conjugation breaking up into spores, the difference between the two processes consisting in the fact that in the one case the spores separate to form an independent organism, while in the other they remain united, and give rise to a single compound organism."

The ovum is treated of in the first chapter as the natural point of departure in the cycle of development—first in its general, then in its special histories in different types. In the second chapter upon Impregnation and Maturation, an account is given of the remarkable researches of Fol and Hertwig, which surpass in the minute history of these changes the observations of any other naturalists. A chapter on Segmentation closes this introductory portion of the work. In view of the fact that this phenomenon hinges upon the disposition of, the presence, or the absence of food-yolk, the author proposes terms for three corresponding types of ova, as follows: (1) Alecithal for ova without food-yolk, or where it is evenly distributed; (2) Telolecithal, where the yolk is concentrated at one pole; (3) Centrolecithal, where the yolk is concentrated in the centre.

The reader is now ready for Part I, Systematic Embryology, in which the history of each group is treated from the formation of the germinal layers onwards, beginning with the simple parasitic forms, the Dicyemidae and Orthonectidae, passing through each invertebrate family whose development has been studied, and closing with the Echinodermata and Eteropneusta.

A detailed review, even of the author's conclusions, would be obviously out of place. Attention may, however, be called to one or two passages of interest, not only to the specialist, but to the general student of biology. The Coelenterata form an attractive group from the fact that they rarely, if ever, pass from the two layered condition, and the lowest forms, even when adult, "do not rise in complexity much beyond a typical gastrula." The larval form, the planula, is common to all except the Ctenophora. Referring to this, the author remarks: "Paradoxical as it may seem, it appears to me not impossible that the Coelenterata may have had an ancestor in which a digestive tract was physiologically replaced by a solid mass of amoeboid cells."

The chapter on the development of the Mollusca is very full and interesting.

In summary of the group Arthropoda, the genealogy of the Tracheata and Crustacea tends to throw doubts upon the uniting of the whole of the arthropoda into one phylum. In the first place, the Tracheata are descended from some terrestrial annelidan type allied to *Peripatus*. [This is the interesting proto-tracheate form collected by Mr. Moseley on the Challenger expedition, and found by him to possess trachea and nephridia, two organs which respectively demonstrate its affinities in opposite lines to the tracheate and annelidan groups.] The Crustacea on the other hand are clearly developed from a phyllopod-like ancestor, which can in no way be related to *Peripatus*. The conclusion that the Crustacea and Tracheata belong to two distinct phyla, is moreover confirmed by their development.

A chapter on the history of the germinal layers is promised in volume second. It is pleasant to find from the names of Agassiz, and Brooks, and others, that Embryology is gaining a sure foothold in this country.

The book throughout evinces the greatest ability and care. Clearness and truth will make it attractive to the student, and it may safely be predicted that a fresh impetus in embryological research among young students in this country and abroad will date from this publication. If this prove to be the case, the author may well feel repaid for his labor. H. F. O.

ON ANGULAR APERTURE OF OBJECTIVES FOR MICROSCOPES. By Geo. E. Blackham, M.D., F.R.M.S. New York Industrial Publication Company. New York, 1880.

We are glad to see that the vexed question of the angular aperture of the objectives has at length been treated in an exhaustive manner by Professor Blackham, who, by an untechnical method of treating the subject, has endeavored to interest a wide range of readers. The work has been produced in handsome form, and has eighteen sheets of diagrams. A critical review of this book will appear at a later date.

COAL.

BY P. W. SHEAFER, M. E., POTTSVILLE, PA.

II.

The fearful loss of good material involved in mining and preparing Anthracite, as shown in the accompanying tables, though greatly to be deplored, seems to be almost inevitable. The disposition of the coal in large solid beds, and in highly inclined positions, involves strong supports to keep the superincumbent mass from crushing and closing the avenues to the mines; and these supports must consist of massive pillars of the solid coal itself. Wooden props, however ponderous and strong, can only be used for the minor supports. Some of this pillar coal is ultimately removed, but much of it is inevitably lost, especially in the larger beds which frequently range from 20 to 40 feet in thickness, and are often inclined at an angle of from 40 to 70 degrees.

It is estimated that not more than 66 per cent. of the coal is ever taken out from the mines. That which is brought to the surface is run through a huge structure from 80 to 100 feet high, very appropriately called a "breaker," ingeniously contrived for the destruction of coal. There are over 300 of these immense buildings in the Anthracite region, costing on an average $50,000 each, or an aggregate of $15,000,000. To the top of these the coal is hoisted, and then descends through a succession of rolls and screens, emerging at the bottom, in a series of assorted sizes, from huge blocks of lump coal to unmerchantable dust, which forms a grievously large proportion of the whole. This process involves a loss of good coal, equal to 20 or 25 per cent. of the entire quantity mined. For the coal wasted in mining, say 40 per cent., and in preparing, 25 per cent., no one is paid; it is a total loss to landowner, miner and shipper.

Plans for utilizing the waste coal dirt, or culm of Anthracite collieries, have been frequently suggested, but none have come into general use. The Anthracite Fuel Company, at Port Ewen, on the Hudson, in 1877, used 90 per cent. coal dust and 10 per cent. fuel pitch, and made 300 tons of fuel per day, consuming over 50,000 tons of culm. The Delaware and Hudson Company also use at their mines 60,000 tons per annum. They now ship all their coal down to pea sizes, and consume the culm in generating steam. If all our coal companies would follow this excellent example it would enable them to sell half a million tons more coal, and burn the same amount of refuse, thus earning or saving half a million dollars per annum, to add to their revenues. The Philadelphia and Reading Railroad Company has recently introduced a method of burning coal dust in the furnaces of its engines, and the plan appears to meet with success.

The amount of water which drains into a mine from a mile or more of surface is enormous, for the average amount of rain and snow fall is 58,840 cubic inches per square yard annually, and the mines are liable to absorb not only the rain fall on the surface immediately over them, but all that which by contour of the surface, or by converging strata, tends towards them. On an average possibly five tons of water are hoisted for every ton of coal raised—another loss chargeable to mining.

The preponderance of waste coal seems excessive; but the writer's experience in surveys of certain tracts of land, and in preparing maps which show the area exhausted, compared with the amount marketed from ten or more colleries, in a period of 20 years, proves that the loss is not over-estimated, especially in the Mammoth Bed, whose average thickness is 25 feet. An eight-foot bed of coal yields much better in proportion. When they exceed six or eight feet in thickness, especially if steeply inclined, they are not only expensive to mine, but a large proportion of the coal must be left to support the rocky roof.

The Bituminous coals, particularly those of the United States, are not subject to these serious losses, and are quite cheaply mined and prepared. No breakers are required, as the only division is into coarse and fine coal, which are easily separated by screens; and the fine coal can be readily converted into coke, making a better condensed fuel than the coal in its natural shape. The Bituminous beds are nearly horizontal and rarely more than six feet thick, so that it is not necessary to leave extensive pillars; and as the coal is above water level, or in shallow basins, it is not necessary to put up extensive hoisting and pumping machinery. The simple, natural ventilation of American Bituminous mines also does away with the extensive and costly appliances for this purpose of Anthracite mines, in spite of which so many miners annually fall victims to the noxious gases.

The total amount of coal still to be mined, according to the accompanying tables, is 26,361,076,000 tons. The total waste, as experience has shown, is equal to two-thirds of the coal deposit, and reaches the appalling amount of 17,574,050,666 tons, leaving us only 8,787,075,533 tons to send to market. In all our calculations of Anthracite we have counted the area as if in a level plain, and made no allowance for the undulations which must necessarily increase the amount of coal. But as many of the flexures are abrupt and broken, making much faulty and refuse coal, it will cover any over-estimate of area or thickness we have made in our calculations.

Our tables show that 360,017,817 tons have been